Boocar Sock
CSC 446

Homework #4

1. a) $-(2^{30}+2^{28}+2^{25}+2^{23}+2^{22}+2^{21}+2^{20}) = -1,391,460,352$

   b) $2^{31}+2^{29}+2^{27}+2^{26}+2^{24}+2^{20} = 2,903,506,944$

   c) $-1.001 \times 2^{-37} = -1.125 \times 2^{-37}$

   d) SW $s0, 0($t0)

2. a) $+(2^{29}+2^{26}+2^{23}+2^{20}+2^{17}+2^{14}+2^{11}+2^{8}+2^{5}+2^{2}) = +24,924,924$

   b) $2^{29}+2^{26}+2^{23}+2^{20}+2^{17}+2^{14}+2^{11}+2^{8}+2^{5}+2^{2} = 24,924,924$

   c) $+1.142857 \times 2^{-54}$

   d) Addiu $s2, $a0, 18724

3.

Ainvert	Binvert	Operation		Result = A op B
0	0	0	0	A AND B
0	0	0	1	A OR B
0	0	1	0	A + B
0	0	1	1	
0	1	0	0	A AND B'
0	1	0	1	A OR B'
0	1	1	0	A + B'
0	1	1	1	
1	0	0	0	A' AND B
1	0	0	1	A' OR B
1	0	1	0	A' + B
1	0	1	1	
1	1	0	0	A' AND B'
1	1	0	1	A' OR B'
1	1	1	0	A' + B'
1	1	1	1	

4. a) $X = 00011001 \rightarrow 25$
$+\ Y = 00001011 \rightarrow 11$
$00100100 \rightarrow 36$

b) $X = 00011001 \rightarrow 25$
$-\ Y = 00001011 \rightarrow 11$
$00001110 \rightarrow 14$

c) $X = 00011001 \rightarrow 25$
$*\ Y = 00001011 \rightarrow 11$

00011001
00011001·
00000000·
0 0011001·

$0000000100010011 \rightarrow 275$

5. $\boxed{-5.5}$

$0.5 \times 2 = 1.0$

$-101.1 \Rightarrow -1.01100\cdots \times 2^2$

- Fraction: 011 0000 0000 0000 0000
- sign: negative $\Rightarrow$ 1
- Exponent: $2+127 = 129 = 10000001_{(2)}$

Fraction: 0110000 ····· 00000
sign: negative $\Rightarrow$ 1
Exponent: $2+1023 = 1025 = 10000000001_{(2}$

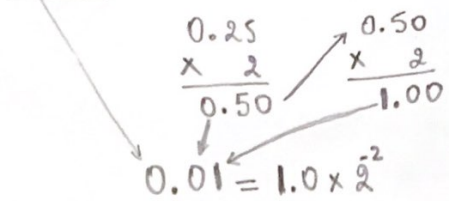
Single precision:

1	10000001	01100000000000000000

Double precision:

1	10000000001	0110 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000		

5. 0.25



- Fraction: 00000…0000
- Signe: Positive ⇒ 0
- Exponent: $-2+127 = 125 = 01111101_{(2)}$

Single precision:

0	01111101	00000000000…0000000

Fraction: 0000….0000
Signe: Positive ⇒ 0
Exponent: $-2+1023 = 1021 = 01111111101_{(2)}$

Double precision:

0	01111111101	00000000000…0000
0000 0000 00000000…. 000000		

6. (-5.5): 11000000101 0110…0000 $= -1.011 \times 2^2$
+ 0.25: 00111 1101 0000…0000 $= 1.0 \times 2^{-2}$

We need to shift the significand of number with smaller exponent.

$0.25 = 1.0 \times 2^{-2} = 0.0001 \times 2^2$

$(-5.5)+0.25 = -1.011 \times 2^2 + 0.0001 \times 2^2$
$= 2^2(-1.011 + 0.0001)$
$= -1.0109 \times 2^2$

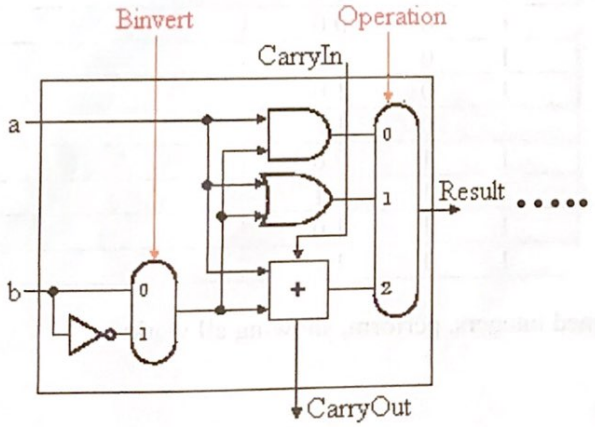
Iteration	Operation	Multiplicand	Product
0	Initial value (load multiplier to the lower half of the product register)	1010	0000 1101
1	Add: Prod = Prod + Mcand	1010	0000 1101
	Shift:	1010	1010 1101
2	Add:	1010	0101 0110
	Shift:	1010	0010 1011
3	Add:	1010	1100 1011
	Shift:	1010	0110 0101
4	Add:	1010	0000 0101
	Shift:	1010	1000 0010

8. Recall the 32-bit ALU discussed in the class shown below. This ALU implements AND, OR, ADD, and SUB. Modify this ALU so it can implements AND, OR, ADD, SUB, and MAX operation. The MAX operation takes the two input words, A and B, and outputs the word that is larger when interpreted as an integer. More formally,

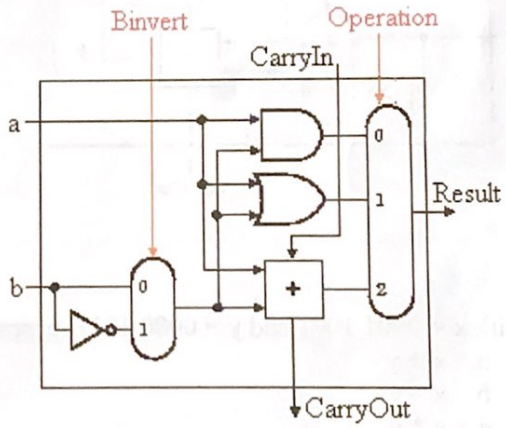
if A > B then
Result = A
else
Result = B
end if

Do your modifications on the following diagram (First modify each 1-bit ALU, then connect them together properly). Also complete the following table to specify the values of the control signals corresponding to the 5 operations that your ALU performs. Hint: for MAX operation, a new MUX is needed, and it will take two steps comparison and assignment just like slt instruction.

1st bit ALU



32nd bit ALU



Operation	Binvert	Operation
A AND B	0	00
A OR B	0	01
A + B	0	10
A – B	1	10
MAX(A, B)	0	11